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## The southern dust pillars of the Carina Nebula

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**Abstract.** We present preliminary results from a detailed study towards four previously detected bright mid-infrared sources in the southern part of the Carina Nebula: G287.73–0.92, G287.84–0.82, G287.93–0.99 and G288.07–0.80. All of these sources are located at the heads of giant dust pillars that point towards the nearby massive star cluster, Trumpler 16. It is unclear if these pillars are the prime sites for a new generation of triggered star formation or if instead they are the only remaining parts of the nebula where ongoing star formation can take place.

### 1. Introduction

There is little dispute that massive stars exist in clusters and are formed within giant molecular clouds (GMCs). All of the early sites of massive star formation that have been identified to date are located in the neighborhood of more evolved massive stars. In many cases, young massive stars have been found at the heads of giant dust pillars that point toward a more evolved massive star cluster (e.g. the elephant trunks of the Eagle Nebula, White et al. 1999). A vigorous debate is occurring on the question of whether this type of star formation has been triggered by the existing cluster or is ongoing. Distinguishing between the two processes will have implications on current massive star formation theories.

The formation of such pillars can readily occur if a dense core within a GMC is exposed to radiation from a nearby massive star cluster. In this case the core would shield the column of molecular gas behind it, in a direction pointing away from the cluster. Subsequently the more exposed parts of the GMC would be swept up around this column or completely irradiated away.

The Carina Nebula, at a distance of 2.2 kpc, provides an excellent laboratory to study the environment of massive stars. The commonly held view is that further star formation in the Carina Nebula is inhibited by the intense feedback processes from the massive stars of Trumpler 14 and Trumpler 16. This view

has recently been challenged with a number of new sources being identified that are good candidates for sites of current star formation (Rathborne et al. 2001, Brooks, Storey & Whiteoak 2001 and Smith et al. 2000). The study by Smith et al. utilised *MSX* data and revealed a region containing a number of bright mid-infrared sources located at the tips of giant elongated emission pillars, all of which point toward the Trumpler 16 cluster. This region is situated in the relatively unstudied southern part of the nebula. Of the four *MSX* bands, the pillars are most prominent in bands A (6.8–10.8  $\mu\text{m}$ ) and C (11.1–13.2  $\mu\text{m}$ ). Both of these bands contain several emission features arising from polycyclic aromatic hydrocarbon molecules (PAHs) which suggests that the pillars are bright photodissociation regions (PDRs).

## 2. Results

We have obtained  $^{12}\text{CO}(1-0)$  and  $^{12}\text{CO}(2-1)$  *SEST* data in the vicinity of four of the bright mid-infrared sources detected by Smith et al. (2000): G287.73–0.92, G287.84–0.82, G287.93–0.99 and G288.07–0.80. Well-defined emission concentrations were detected toward all four sources yielding relatively cool excitation temperatures of 5–20 K. For G287.93–0.99, additional observations of  $^{13}\text{CO}(2-1)$  were extended over a larger area. The detected emission closely follows the morphology of the associated mid-infrared pillar, confirming that it is a structure of inter mixed molecular gas and dust surrounded by a PDR. A  $^{13}\text{CO}$  concentration at the head of the pillar yields both an LTE and Virial mass estimate of 700  $\text{M}_{\odot}$ .

Preliminary analysis of *2MASS* data in the vicinity of the four mid-infrared sources, reveal a number of candidates for young embedded objects. In particular, for G287.84–0.82 there is evidence for an embedded young stellar cluster. It is tempting to conclude that this cluster is an example of triggered star formation. Under this premise, any new stars should preferentially form at the heads of the pillars, which are the parts that are most exposed to the interaction of winds and UV radiation from the existing nearby massive stars. However, one can also argue the heads of the pillars are the remaining dense cores of the original GMC and are therefore likely to have formed stars regardless.

With further analysis of *2MASS* and *MSX* data we hope to distinguish between triggered or ongoing star formation. For example, if we find new star formation in a number of molecular concentrations throughout the pillar then these new stars are more likely to be the result of an ongoing star formation process which also formed the Trumpler 16 cluster.

## References

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